

TR05-001-e

Gaze and exploration of visual environment

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Visual perception is achieved through multiple orienting eye and head movements, allowing change of gaze with brief short period of fixations. These periods of fixation are used to collect multiple snapshots to be integrated as a stable and coherent spatial representation of the environment, in accordance with attentional mechanisms. In a first lecture, I will present the objective of eye movements and their anatomical and physiological organization, with a specific attention to saccades and smooth pursuit. The lecture will be punctuated with video of clinical cases in order to emphasize the different steps necessary to assess clinically eye movements and their disorders and to illustrate the consequences of eye movement disorders. More precisely, physiology and pathology of infra and cortical smooth pursuit and saccadic control, with resulting disorders such as supranuclear palsy, cerebellar saccadic or smooth pursuit dysmetria and oculomotor apraxia will be presented.

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Gaze, attention and spatial remapping

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The impression created by vision is that of a coherent, richly detailed world where everything is present simultaneously. Although our environment is certainly this way, it is unlikely that our brains contain such a picture-like representation of the visual world that is stable, coherent and everywhere detailed. Vision is an active process involving constant covert and/or overt exploration of the external world supported by remapping mechanisms responsible for the integration of these different points of view over time and space. Evidence will be reviewed that the posterior parietal cortex is a crucial cortical region for mechanisms of visual attention and remapping, as suggested by the Balint-Holmes syndrome. We will present data showing that the superior parietal lobule is involved in shifting and maintaining endogenous attention to contralateral visual field, knowing that following damage to the right inferior parietal lobule the basic mechanism leading to neglect is an impaired exogenous orienting. An additional key component of neglect involves an impairment of spatial remapping, leading to visual disorganisation symptoms in the entire space. We review findings suggesting a specific role of the right temporo-parietal junction for remapping which subsequently transfers target location information to downstream saccade planning regions that are symmetrically organized.

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Eye movements in visual mental imagery: The mind's eye revealed by ocular trackingM. Fourtassi^{a,*}, G. Rode^b, L. Pisella^c^a *Faculté de Médecine et de Pharmacie d'Oujda, Université Mohammed Premier, Oujda, Morocco*^b *Hospices civils de Lyon, Lyon, France*^c *Inserm, CRNL, Bron, France*

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Keywords: Mental imagery; Eye movements; Neglect; Hemianopia
The study of oculomotor behavior during visual mental imagery (VMI), in patients with impaired mental representations or with visual cortex lesions, might

its underlying anatomic substrates. Ten healthy subjects, three patients with lateral hemianopia and one patient with representational neglect were asked to name towns they could localize on an imagined map of France, without previous perceptual input, while their eye movements were recorded. The gaze positions consistently correlated with the towns' real GPS locations in every healthy subject, but in no one of the hemianopia patients and only for the right-sided towns in the neglect patient. Using specific tools developed by geographers, we could identify, for each healthy subject, the generation of iterative small series of towns, mapped with the different spatial distortions. VMI is a dynamic process in which eye movements might play the role of spatial indexes to generate a series of small mental images on a supposedly limited capacity visual buffer. The integrity of the visual cortex might be necessary to this process along with attention pointers to localize pieces of the internal image on this buffer.

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Task-specific eye movement therapies for patients delivered via the Internet

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There is good evidence that compensatory eye movement therapies improve visual function in patients with persisting hemianopia. These therapies tend to be task specific and do not interact with each other. I have developed two web-based therapies that improve reading and visual search in hemianopic patients: Read-Right (for hemianopic alexia) and Eye-Search (for visual search impairment). These web-apps include a validated visual field test, a neglect test, patient reported outcome measures and appropriate impairment-based outcomes (reading speed for Read-Right and a speeded test of visual search in Eye-Search). I will present the latest data from the two websites. Is this the future for targeted neurological rehabilitation?

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Perspectives in acquired visual field defects rehabilitation

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Visual field deficit (VFD) is one of the most commonly observed symptoms following brain injury. Persistent VFD and defective exploratory oculomotor scanning patterns often cause severe impairment in daily activities, particularly as regards visual exploration and reading. Homonymous hemianopia is consequently a powerful negative predictor of patient outcome. In spite of these quantitative and qualitative factors, there currently exists no consensus on rehabilitative therapy and treatment. Different approaches have nevertheless been developed, all of them having one therapeutic principle in common; repeated practice of a specific visual task, with the hope/expectation that improved performance will extend to a wide range of ecologically useful visual functions. Four main methods are available (optical therapy using prisms, restorative therapies, stimulation of blindsight and compensatory therapies). We will present the key data relative to these different approaches in terms of behavioural or imagery results. It also aims at critically analyzing the advantages and limits of each one. The importance of strict assessment in terms of deficiencies or disabilities is underlined. It is finally suggested that efficient treatment would probably have to associate general components and more specific elements, according to what may be done with regard to other aspects of cognitive rehabilitation.

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